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Lat 39,10378 Lon -120,79123

File Code: 3400
Route to: 2470

Date: July 14, 1995

Subject: Pruning Sugar Pine Plantations for White Pine Blister Rust (BE #NE95-10)

To: District Ranger, Forest Hill RD, Tahoe NF

A field review to assess white pine blister rust (WPBR, caused by the fungal pathogen Cronartium ribicola) on sugar pine in two Forest Hill RD plantations was conducted by FPM and the R5 Sugar Pine Group on June 6. Gail Parn, District Silviculturist, and Chris Rowe, Forest Technician, accompanied Bill Woodruff (plant pathologist from the Susanville FPM Service Center) and Safiya Samman and Paul Stover (Geneticists from the Sugar Pine and Central Zone Genetics Programs at Camino) to plantations #20 and #31 along FS road #3127-8 on the Forest Hill Ranger District.

The purpose of the review was to analyze the District proposal to prune sugar pine for WPBR control on a number of 10-15 year old plantations which also contained ponderosa pine and Douglas fir. The largest sugar pine component, of approximately 80 trees per acre, in all the proposed plantations was in plantation #20. Precommercial thinning to enhance tree growth would be accomplished at the same time.

Upon arrival at plantation #20, Safiya Samman showed the group how to identify WPBR in various stages of development on 15 year old planted sugar pine. She also pointed out several WPBR resistance mechanisms that were evident on some of the sugar pine. Reference was made to the PSW, USDA pamphlet "How to Identify Blister Rust Infection and Resistance in Sugar Pine" by S. Samman and J. Kitzmiller. Copies of the pamphlet were distributed. Safiya also explained how to age WPBR infections and assess disease impacts on the host. We then proceeded to plantation #31 and conducted a disease assessment on a small area in this plantation.

Observations

There were numerous WPBR infections in both plantations, ten percent of the sugar pine were rust-free. In both plantations the WPBR infections were confined to the lower 4 feet on the examined sugar pine, except for one tree in #20 that had a bole infection about 10 feet off the ground. WPBR infection wave years in both units were 1986, 1989 and 1992 with 47% of th infections originating on 1986 wood. A wave year is one in which climatic conditions are favorable for WPBR infections. Infection frequency ranged from one to 7 infections per tree.

Sugar pine stocking was higher in #20 than in #31. Ribes populations were low in both plantations. Tree height growth was good in both plantations, though probably a little better in plantation #20. Mortality from WPBR was evident in both plantations close to 20% in #31. Some sugar pine exhibited resistance reactions to WPBR. For example, a nine year old branch infection on a sugar pine in plantation #20 was contained and had not expanded towards the bole. Other forms of resistance identified were bark reactions, partial bark reactions and twig blight.

Alternatives

A. No Action

If left untreated, it is estimated that 10 percent of the sugar pine will survive WPBR and reach maturity. Existing WPBR infections on the sugar pine will continue to expand on the branches of sugar pine which don't have resistance. These infections will eventually reach the boles, girdle them, and kill the trees. Sugar pine with various resistance mechanisms will slow or arrest WPBR infections. Some of these will survive until maturity.

New WPBR infections will continue to develop when favorable conditions exist. These infections will most likely be higher in the tree where targets are present. The trees exhibit a 3-4 years needle retention which means the target area for infection is enhanced.

Stand #20, with approximately 80 sugar pine per acre, should have 8 sugar pine at maturity. This was thought to be sufficient stocking. However, the other stands considered for treatment currently have fewer sugar pine per acre. These stands will probably be understocked with sugar pine at maturity.

Stands in need of precommercial thinning will remain overstocked. This will reduce tree growth and vigor, which will increase tree susceptibility to insects and diseases.

B. Prune all Sugar Pine and Thin Stands

This alternative would entail pruning the lower half of the crown of all sugar pine trees in the plantations and removing all sugar pine with active WPBR infections on the boles. The conifers in the stands will be thinned to remove diseased or undesirable trees. Opening the stands will allow the trees to continue vigorous growth and will help make the stands resistant to crown fires. Slash will be removed or treated to reduce the fire hazard.

Virtually all of the existing and incipient WPBR branch infections will be removed. Pruning the lower branches will remove the needles (branches) where most WPBR infections had occurred in the past (ie. in the lower four feet of the trees). This alternative will reduce the production of spores which would reduce inoculum levels in the stand.

As noted by Safiya, pruning branches with advanced WPBR infections does not always remove all the disease from the tree. Often, fungal growth advances into the bole, well ahead of the visible symptoms on the branches. Consequently, pruned trees will have to be monitored in the future to

identify active WPBR bole infections. Subsequent active bole infections may occur which will eventually kill the affected sugar pine. When identified, these trees can be removed or retained in order to meet current management objectives.

It is important to monitor the stands at least five and ten years after pruning, to evaluate the effectiveness of the pruning. The percentages of sugar pine with and without subsequent WPBR bole infections should be noted. Additional branch infections may occur. These should be evaluated to assess the need for additional pruning, and to determine the height we can expect WPBR to occur in these stands. The height of WPBR infection is variable and dependant upon local climatic conditions.

Old WPBR infections that haven't advanced into the bole may have been inhibited by a resistance reaction in the tree. These infections are probably not a threat to the tree. In the long range these resistant trees would be a source of resistant pollen and seed for regenerating the stands. In deciding whether to prune resistant trees, one should consider the other benefits derived. Pruning will not only remove infections, it will reduce the susceptibility of the tree to damage from ground fire when the slash is removed. In the long run, pruning also can increase the quality of the lumber in the pruned bole.

C. <u>Prune all Conifers and Thin Stands</u>

This alternative is the same as Alternative B, except that all the conifers will be pruned. The purpose of pruning all the trees would be to remove the ladder fuels and allow ground fires to burn in a stand without destroying all the trees. In Alternative B, even thought individual sugar pine might be more fire resistant, a ground fire could climb through the ladder fuels present in adjacent conifers and consume the sugar pine as well. Treating only the WPBR overlooks the potential of the stand to be destroyed by fire. In addition to removing ladder fuels, pruning all the conifers has the benefit of removing infection sites on lower branches for diseases such as the dwarf mistletoes, which often get first established low in the crowns of conifers. As in Alternative B, the conifers in the stands will be thinned resulting in the same benefits.

This alternative would open up the forest floor to solar radiation, increasing vegetative growth. Ribes, the alternate host to WPBR would become more prevalent. There would be more rust spores produced with more Ribes in the stands. Since the WPBR inoculum appears to be coming from outside the stands, more rust inoculum in the stand should have little adverse affect on the sugar pine; especially when the primary target for the spores, the lower branches have been removed.

The increased growth on the forest floor will persist until the overstory canopy grows together, stopping the sunlight from reaching the ground. When this occurs, understory vegetation will gradually die. Underburns, prescribed or natural, will remove ground fuels, recycle nutrients, and result in additional pruning higher on the bole. This natural pruning, along with mechanical thinning and any natural thinning resulting from fire, will further open the stands. The long-term result will be stands

and trees resilient to disturbance and resembling conditions prior to this century.

As with Alternative B, it is essential to monitor the treated stands five and ten years after treatment to assess the effectiveness in controlling WPBR, and to prescribe additional treatments as needed. Prescribed underburns may be necessary to mimic natural stand conditions for this ecosystem. Fire specialists should assess the stands for unberburning.

D. Prune Sugar Pine and/or Conifers and Thin Conifers on Parts of the Stands

This alternative would be a combination of two or three of the previous alternatives. The purpose would be to compare the effectiveness of the various treatments for control of WPBR. Each treatment will contain a minimum of 100 larger sugar pine. (Sugar pine less than about eight feet tall don't count)

Each stand will contain one or more untreated area(s) as described in Alternative A, and corresponding treatments as in Alternatives B and/or C. For example, if a plantation of 6 acres has 50 sugar pine per acre, three two acre treatments could be accomplished: one no action, one prune sugar pine and thin all conifers, and one prune and thin all conifers. An 8 acre plantation could have two no action treatments and two prune sugar pine and thin all conifers.

As with the other alternatives, it is essential to examine the plantations at least five and ten years after the pruning to determine the effectiveness of the various treatments. Future action will be determined with the results of this monitoring.

The R5 Sugar Pine Program Manager, Safiya Samman (phone: (916) 642-5000), and Plant Pathologist, Bill Woodruff are available to review proposed treatments or to answer questions as they arise. In addition, these people or their successors should be contacted for assistance for the five and ten-year monitoring.

Bill Woodruff

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Plant Pathologist